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TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/DE 98/03270

Nov 10, 1998

Nov 11, 1998

TITLE OF INVENTION

Multi-point, one-piece seat belt

APPLICANT(S) FOR DO/EO/US

Giok Djien Go

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☐ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☒ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)). See C
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☒ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). See M
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment. See C
14. ☒ A SECOND or SUBSEQUENT preliminary amendment. See M
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ Other items or information:

List of PCT/DE 98/03270 documents

17. ☐ The following fees are submitted:**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):**

Search Report has been prepared by the EPO or JPO ..... \$910.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... \$700.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$770.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$1040.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$96.00

**ENTER APPROPRIATE BASIC FEE AMOUNT =****CALCULATIONS PTO USE ONLY**

\$ 690

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).

\$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	41 - 20 =	21	X \$22.00
Independent claims	5 - 3 =	2	X \$80.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$260.00

\$ 462

\$ 160

\$ 260

**TOTAL OF ABOVE CALCULATIONS =**

\$ 1572

Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).

\$ 786

**SUBTOTAL =**

\$ 786

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).

\$

**TOTAL NATIONAL FEE =**

\$

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +

\$

**TOTAL FEES ENCLOSED =**

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Amount to be:  
refunded

\$

charged

\$

a. ☒ A check in the amount of \$ 2000 to cover the above fees is enclosed.

two 1600 + 400

b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees. A duplicate copy of this sheet is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. \_\_\_\_\_. A duplicate copy of this sheet is enclosed.

See letter to "Deposit Accounts" Box 16

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

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NAME

REGISTRATION NUMBER

9/8/85

426 Rec'd PCT/PTO 19 APR 2000

## MULTI-POINT, ONE-PIECE SEAT BELT

### CROSS REFERENCE TO RELATED APPLICATIONS

5 This is a continuation-in-part application of co-pending international application number PCT/DE98/03270 (WO 99/24294) filed Nov. 10, 1998 and claiming the priority of DE 197 49 780 A1 filed Nov. 11, 1997 is revised and refiled.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention:

10 It is an object of the present invention to improve the restraint of a passenger in order to lower all acceleration-dependant loads

- in the event of any accident (front-, side-, rear-end collision and/or rollover or pile up/mass collision) of a motor vehicle, in particular, a car, school-bus, bus or truck, of train (commuter train) or of an aeroplane or
- 15 – during turbulence-related vibration of an aeroplane thus enhancing survival chance.

#### 2. Discussion of the Prior Art:

It is known in the prior art to provide

- a three-point seat belt (safety belt or lap-shoulder seat belt assembly), mounted in a motor vehicle, consisting of a shoulder belt extending across the upper part of body and of a lap belt extending across the lower part of body;
- 20 – a two-point seat belt, mounted in aeroplane, acting as lap belt extending across the lower part of body or
- 25 – a suspender- (waist-) belt consisting of several pieces (belt-members).

It is well known to provide different restraint systems in vehicles, predominantly, three-point seat belts in various types for seats, exemplified by DE 37 41 831 A1 shown in Fig. 11. Evidently, when both shoulders of a passenger, conventionally belted, are not restrained in the event of an arbitrary collision with another vehicle in any direction, shown in Figs. 3, 4 and 7, the unrestrained shoulder can always move and/or rotate freely, thereby resulting in

30 severe/fatal injuries in a number of accidents when

- the head crashes against the steering wheel and/or window pane and/or
- the airbag crushes the head, which, loaded by the forces related to pitch-acceleration  $\ddot{U}_H$ , yaw-acceleration  $\ddot{O}$ , longitudinal and/or lateral acceleration, is in "oop" (out of position).

35 Moreover, by the definition of „submarining“ the belted passenger submarines (slips downward) under his seat belt thus negating the protective effect of the seat belt.

It is well known to provide a two-point or lap seat belts for aeroplane seats as well as mid-portion of the rear seat of the vehicle. This lap seat belt is far less effective than a three-point seat belt. Due to very large accelerations during a turbulence-related flight the protective effect is very low.

40

A substantially improved protection is proposed by two different configurations of a one-piece seat belt, exemplified by DE 26 02 875 A1 (Figs. 8 to 10). An „X-shaped“ restraint is arranged by extending both shoulder belts crosswise over the upper part of body while the lower part of body is restrained by the lap belt. Each end of the one-piece seat belt is

45 connected to a belt retractor, fastened in the seat backrest. Two grab rings, positioned to the headrest, move along the belt. A single or double „X-shaped“ configuration is defined by pulling a pair of grab rings and belt portions over the head, shoulders and head rest and

engaging them in the corresponding hooks. Due to such intricate operation the seat belt remains unused.

According to US 3,977,696, US 5,123,673, US 5,411,319, DE-OS 23 45 847, DE-OS 28 13 888 and DE 196 29 878 A1 the restraint system comprises a three-point seat belt, a second shoulder belt and two belt retractors, responsible for retracting both belts. The „X-shaped” configuration, formed by extending both belts crosswise over the upper part of the body, has the following drawbacks in the event of an accident:

- I. Both belts are retracted to different length by two independently operating belt retractors within milliseconds.
- II. Under the load of the same belt force in a front collision the deformation of seat backrest, wherein both belt ends are fastened, is larger, thus increasing the forward motion. Furthermore, it is impossible to attach an energy absorber because all four belt ends are occupied.

A one-piece seat belt 1 (Fig. 1) ref. to DE-OS 28 13 888 is equipped with two belt retractors (not drawn), fastened to both belt ends in the seat backrest, and a belt deflector 17, anchored to the seat frame 3.3 of the mid-portion of rear seat. The feature has the following drawbacks:

- When the release button 84 is pressed, the belt portion 1.1 gets entangled around the neck of passenger. For the operation of restraining and extending both belt portions into the „X-shaped” configuration, the passenger must lower his head first.
- Because all belt ends are occupied, it is impossible to attach an energy absorber and to adjust the belt to the height of the upper part of body 95.

Generally, a child-seat is fastened by four auxiliary belts to the seat. Despite the „X-shaped” configuration of a one-piece seat belt to restrain a child, sitting in a child-seat, ref. to FR 2 342 872 A1 the problems, associated with the retraction of four auxiliary belts, submarining and energy absorption, remain unsolved in an accident.

Till now, trains, school buses and buses are not provided with restraint systems.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a one-piece seat belt with a single belt retractor, solely responsible for the retraction or protraction, a belt deflector to loosely guide a belt portion and multi-attachment points,

- to enhance the convenience and comfort of the passenger and
- to restrain the passenger in multi-attachment points (multi-points of restraint), in order to distribute the acceleration-dependent loads, shown in Fig. 3 and Tables 1 to 3, to the multi-attachment points in the event of any collision of a vehicle, train or aeroplane or any turbulence-related vibration of an aeroplane.

This principle and other objects of the present invention are accomplished by the following features (proposals):

- user-friendly belt-feeding device to ease the restraint and
- integration of the multi-point seat belt 1, 1a to 1d, equipped with energy absorbers and the seat 3, 3a to 3d, into a baby-cot, child-seat or safety seat, illustrated in Figs. 1, 23. in order to control all acceleration rates and loads below the respective injury-related values during the arbitrary real collision, thus ensuring the restraint function and saving life.

Summary of the advantages of the present invention in real accident:

- The survival chance is enhanced by the restraint of
  - \* both shoulders and the torso, when the passenger is thrown forward (Fig. 4, Table 3) and/or subjected to the yaw  $\ddot{O}$ -acceleration-dependent torque  $T_{\ddot{O}}$ , and
  - \* both thighs and the lower part of the body, when the passenger submarines.
- Because the belt retractor is attached to one belt end, a number of sets of energy absorbers ref. to WO 99/24292 (PCT/DE98/03271, DE 197 58 498 A1) or DE 197 58 497 A1 can be attached to the other belt end (Figs. 12a, 12b, 18), thus gradually absorbing large impact energy below the respective injury-related values. Both applications are issued by to the inventor of the present application. The energy absorber consists of a number of clamping elements, having sites of predetermined fracture, and a retaining element, fastened to the seat backrest frame, seat frame or serving as an integral part thereof.
- Owing to the different positions of buckle assemblies, in plug-in connection with the respective latch plates, passengers of different body proportions can adjust the belts by themselves. Moreover, seats, equipped therewith, for adults can be modified for the children and vice versa, thus augmenting the rate of seat occupancy in a bus, train or an aeroplane, exemplified in Fig. 23.
- In another embodiment the latch plate 5b (Fig. 15), in plug-in connection with the buckle assembly, or the buckle assembly is height-adjustable. Energy absorbers ref. to DE 197 58 497 A1 can be connected to this buckle assembly. Upon the use of the height-adjustable latch plate 5b the height-adjustable D-ring 12, attached to the B-, C-, D-post section (pillar, pillar portion), shown in Fig. 1, or to the top edge of the seat backrest, is no longer needed.
- In another embodiment the belt deflector 5a (Fig. 13) can be rigidly attached to the head rest 3.6a. Any adjustment of the height of the head rest 3.6a to the head automatically adjusts the height of the belt deflector to the shoulder. This feature differs from the D-ring ref. to DE 40 10 452 A1, which is in contact with the shoulder belt, when the passenger is thrown forward, and is moved up to intercept the head, when thrown backward.
- In resting position the latch plate 2, in plug-in connection with the side buckle assembly 16, 16a, 16b fastened to the seat cushion 3.1, B-, C-post section or seat backrest (Figs. 1, 2), is easily accessed by the passenger for the purpose to belt.
- The seat belt can be equipped with a belt-feeding device, manually operated or by a drive apparatus e.g. hydraulic-piston cylinder unit, electrical motor (not drawn), which enhances the convenience and comfort of the user. This drive apparatus is switched on by a pressure sensor, built to the seat, or an existing switch such as lighting-, door- or touching switch. If the belt is not engaged within a dwell time, a control device is activated to switch-off the drive apparatus and to reposition the belt-feeding device in resting position.
- For the convenience of the passenger or a quick-rescue of the passenger in case of an emergency and/or accident the master release button 84 of the buckle assembly 9.1 is pressed to release all latch plates from the buckle assemblies.
- The round rollover tubes 20.2b of the seat backrest frame 3.4d are designed to guide the belt housing 20.4c, 20.4d (Figs. 18, 19) and in rollover to act as safety bars, having openings 97R, 97L (Fig. 23) to allow free view to the rear.
- In another embodiment the seat belt can be connected to the seat in more than three attachment-points (Figs. 1, 14, 23), in which both thighs (femurs) are restrained, thus protecting the passenger against submarining in front, rear collision or rollover or when in sleeping position. Unlike the suspender- (waist-) belt, consisting of several belts, the portions of multi-point seat belt need not be adjusted in length, when the circumference of the passenger varies depending on the clothes worn.

## BRIEF DESCRIPTION OF THE DRAWINGS

A number of embodiments, other advantages and features of the present invention will be described in the accompanying tables and drawings with reference to the xyz global coordinate system:

- 5 **Table 1** shows test data such as left / right thigh-force, belt force and pitch-angle of driver and co-driver in 50% offset crash test of several European vehicles [2].  
**Table 2** shows yaw angle  $O$  of driver / co-driver in 50% offset crash tests [3].  
**Table 3** shows test data of the safest child-restraint system Chico Shuttle® at the converted velocity of 55 km/h in comparison with the safest vehicle [4].
- 10 **Fig. 1** is a perspective view of a seat with buckle assemblies attached to the seat backrest and seat cushion as well as of the 1st embodiment of restraint system consisting of a multi-point seat belt 1, latch plate 11 along the lap belt, latch plate 2 of belt end, in the direction of arrow „Z” in plug-in connection with a buckle assembly 4, and a seat belt in X-shape, formed by crossing both shoulder belt portions 1.1, 1.2.
- 15 **Fig. 2** is a perspective view of a seat and of the 2nd embodiment of a restraint system comprising three-point seat belt 1e having a latch plate 2, which will be inserted into a buckle assembly 4e of a shoulder belt 1.11, pulled in the direction of arrow „Z”.
- Fig. 3** illustrates load cases I, II and III in z-y plane in the event of arbitrary real collision.
- 20 **Fig. 4** is a perspective view of a restrained dummy thrown forward in VW Polo® in 50% offset crash test.
- Fig. 5** illustrates a yaw-acceleration  $\ddot{O}$  and yaw-angle  $O$  of a vehicle about the vertical axis „z<sub>A</sub>” in 50% offset crash test of two identical vehicles [5].
- Fig. 6** illustrates a yaw angle  $O$  of vehicle about the vertical axis „z<sub>A</sub>” in 50% offset crash test against a stiff barrier.
- 25 **Fig. 7** illustrates four collision types U1 to U4 [1].
- Fig. 8** is a front view of a seat belt ref. to DE-OS 26 02 875 in home position.
- Fig. 9** is a front view of a double X-shaped seat belt ref. to DE-OS 26 02 875.
- Fig. 10** is a front view of a single X-shaped seat belt ref. to DE-OS 26 02 875.
- Fig. 11** is a top view of a  $\angle$ -shaped seat belt ref. to DE 37 41 831 A1.
- 30 **Fig. 12a** is a schematic, perspective view of the 1st embodiment of a buckle assembly 4a, equipped with release cable 4.2.
- Fig. 12b** is a schematic, perspective view of the 2nd embodiment of a buckle assembly 4b, equipped with an electrical motor 4.2b.
- Fig. 13** is a perspective view of a belt deflector of the head rest.
- 35 **Fig. 14** is a perspective view of a latch plate 11 of a lap belt portion 1.3 in plug-in connection with a buckle assembly 8 and of the 1st embodiment of a belt-feeding device 20 of the seat belt.
- Fig. 15** is a perspective view of the 2nd embodiment of a spatially-adjusting belt-feeding device 20a from the resting position to the operating position and of a height-adjustable belt deflector 5b.
- 40 **Fig. 16** is a schematic view of the 2nd and 3rd embodiment of spatially-adjusting belt-feeding devices 20a and 20b in kinematics from the operating position to the resting position in x-y plane.
- Figs. 17a to 17f** are schematic, perspective views of the belt-feeding device 20 in kinematics from the resting position to the operating position.
- 45 **Fig. 18** is a schematic, perspective view of a seat, equipped with the rollover tubes 20.2b, and of the 4th embodiment of a belt-feeding device 20c.

Fig. 19 is a schematic, perspective view of a seat having the rollover tubes 20.2b, the 5th embodiment of a belt-feeding device 20d, provided with a safety bracket 20.6, a height- and width-adjusting mechanism 27, 27a.

Fig. 20 is a cross-sectional view of the 1st embodiment of the height- and width-adjusting mechanism 27 along the line I-I of Fig. 19.

Fig. 21 is a cross-sectional view of the height- and width-adjusting mechanism 27 along the line II-II of Fig. 20.

Fig. 22 cross-sectional view of the 2nd embodiment of the height- and width-adjusting mechanism 27a along the line I-I of Fig. 19.

Fig. 23 is a front view of the seat 3a to 3d, in which the restraint systems 1a to 1d are integrated, for passengers of different weights and body proportions (sizes).

## DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

The advantages of the preferred embodiments, above-mentioned in the Chap. "Summary of the advantages...", are outlined hereinafter with regard to the functions and features thereof.

The method of the present invention capitalizes on the premise that a one-piece seat belt is employed to restrain a passenger in at least four attachment points of the seat to distribute the loads thereto and sustain the yaw  $\ddot{O}$ -acceleration-dependent torque  $T_{\delta}$  in an accident, thus ensuring the operation of a single belt retractor to pre-tension (bias) as well as tension the belt, restraining both shoulders, upper- and lower part of the body and lowering loads, in particular, in co-operation with the energy-absorption when a number of sets of energy absorbers is put into use. This will be apparent by formulating all forces, imposed on the belted passenger, shown in Figs. 3 and 4, in the event of a front collision, where the loads of the mass  $D_S$  of the torso are lowered because

- the forward motion „ $w_v$ ” is minimized, thus substantially reducing the pitch-acceleration  $\ddot{U}_H$  and force  $F_{Hy}$  of the mass  $D_H$  of the head, and
- the yaw-acceleration  $\ddot{O}$  is minimized, thus substantially reducing the torque  $T_{\delta}$ , imposed on the head. The torque  $T_{\delta}$  is the most latent force, responsible for fatality.

Hence, massive head injuries related to [6 to 9] can be avoided.

Load case I in z-y plane: The rotating mass  $D_S$  rotates about the rotating axis „S” at the pitch-angle  $U_S$  and mass  $D_H$  about the rotating axis „z” at the pitch-angle  $U_H$  in Table 1, thereby resulting in the pitch-accelerations  $\ddot{U}_S$ ,  $\ddot{U}_H$  and rotating forces  $F_{Sy}$ ,  $F_{Hy}$ . The addition of both rotating forces yields the force  $F_v$  of forward motion  $w_v$  of passenger, shown in Fig. 4. In front- and/or rear collision the passenger is exposed to the submarining force  $S_y$ , shown in Fig. 14.

Load case II in x-y plane: The upper part of body is subjected to the torque  $T_{\delta}$ , exerted by the yaw-acceleration  $\ddot{O}$  about the rotating axis „z”.

Load case III in x-z plane: The rotating mass  $D_S$  rotates about the rotating axis „S” at the rotating angle  $U_y$  and mass  $D_H$  about the rotating axis „z” at the rotating angle  $U_{Hy}$ , thereby resulting in the rotating accelerations  $\ddot{U}_y$ ,  $\ddot{U}_{Hy}$  and rotating forces  $D_{Sy}$ ,  $D_{Hy}$  (not drawn). In rollover the passenger is subjected to the load  $F_{Sz}$ .

Load case IV: In turbulence-related vibration of an aeroplane the load  $D_{Sy}$  together with  $D_{Hy}$  takes the form of periodical load  $\pm F_{Hx}$ ,  $F_{Sz}$  of  $\pm F_{Sz}$ ,  $T_{\delta}$  of  $\pm T_{\delta}$ ,  $S_y$  of  $\pm S_y$  and  $F_{Sy}$  together with  $F_{Hy}$  of  $\pm F_v$ .

The restraint system, illustrated in Fig. 1, is provided with the conventional belt retractor 13, whereto the belt end EL is connected, and a clamping device, both pieces are arranged in the B-, C-, D-post section or in one of both sides SL and SR of a seat backrest 3.2 or to the floor 6.

5 The other belt end ER is provided with a latch plate 2, which is retained, loosely guided by a belt deflector 17, fastened to the floor 6, side rail or seat frame. This belt deflector 17 replaces the conventional fitting, fastened to the side rail, to receive to the belt end of the three-point seat belt. The latch plate 2 is plug-in connected to one of the buckle assemblies 4, 4b, 4c, 14, 14a, 18, 18a, 18b, arranged in or to the seat backrest 3.2. However, in another  
10 embodiment, described hereinafter, the other belt end ER is secured in the side SR of a seat backrest, shown in Figs. 18, 19.

In all embodiments an additional latch plate 9 can move along the seat belt 1 between both belt ends EL and ER. When plug-in connecting the latch plate 2 (in the direction of arrow „Z“) to the buckle assembly 4 and the latch plate 9 to the buckle assembly 9.1, the X-shaped  
15 restraint of the upper part of body and both shoulders are achieved by both belt portions 1.1, 1.2 and the restraint of the lower part of body is achieved by the lap belt portion 1.3.

In various embodiments the X-shaped restraint of the upper part of body can be achieved by both belt portions upon plug-in connection of

- a *number* of latch plates 2, 9, 11, 25 with the respective buckle assemblies 4, 4a to 4c, 4e, 7, 8, 8a to 8d, 9.1, 14, 14a, 15, 15a, 18, 18a, 18b, 18.1 to 18.3, 19, 19a, 19b, 19.1 to 19.3 (Figs. 1, 14, 19, 23), thus increasing the multi-attachment points, which can be provided with sets of energy absorbers ref. to DE 197 58 497 A1 as well as WO 99/24292 for the purpose of increasing the distribution and absorption of great energy; *or*
- a *single* latch plate 9 with buckle assembly 9.1 upon the use of the belt-feeding device 20, where the belt end ER is connected to the seat backrest frame or the sets of energy absorbers (Figs. 18, 19), for the enhanced comfort of the sitting passenger (Figs. 14, 17a to 17f), maintaining the common practise to operate the conventional three-point seat belt and enforcing the passenger to use a seat belt. However, the distribution of loads to the multi-attachment points can be increased by additional plug-in connection of the latch  
25 plates 11, 25 with the respective buckle assemblies, shown in Fig. 23.

As shown in Figs. 1 and 14, the seat belt 1 is equipped with a third latch plate 11, which can be connected to one of the buckle assemblies 7, 8, 8a to 8d, arranged in or to the seat frame 3.3. When plug-in connected, the lap belt portion 1.3 is subdivided into two belt portions 1.3R, 1.3L. Owing to the restraint of both thighs the submarining problem in front- or rear  
35 collision, in rollover or turbulence-related vibration of an aeroplane is resolved. Moreover, the passenger, lying in a sleeping position ref. to DE 37 41 831 A1 (Fig. 11), is well protected.

Because the reel (spool) of the conventional belt retractor can accommodate only a limited length of belt, it is possible that the length of the seat belt for the sleeping position is  
40 insufficient. As exemplified in Fig. 1, a buckle assembly 8b, 8c is provided with a release button 84e and a length-adjustable belt, fastened to the seat frame, for the purpose of compensating the length of seat belt 1 between the sleeping and normal position.

A buckle assembly 8d, provided with a release button 84d, is attached to the front portion of the seat cushion.

45 Owing to the plug-in connection of latch plates 11, 25 with the respective buckle assemblies a lady in a long gown as well as a child are well protected from submarining (Fig. 23).



The belt deflector 17 comprises a housing having an attachment hole to receive a bolt 17.1. Both parts can be made in one piece. If necessary, the bolt 17.1 is surrounded by a sleeve 17.2 of plastics, having corrugation or knobs, which is a common part of the conventional D-ring 12. This D-ring 12 is suitable too for the belt deflector 17. The aperture of the belt deflector 17 to loosely guide the belt portion is dimensioned to that size to retain the latch plate 2 in resting position, thus allowing the use as a three-point seat belt.

In the 1st embodiment ref. to Figs. 14, 17a, 17d the belt-feeding device 20 in resting position is provided with a device to countersink the belt-feeding plate 20.9 in the seat backrest to improve the overall impression of the seat-design, whereon the sales success depends.

When the passenger takes his seat, a drive apparatus is activated to

- move up the belt-feeding plate 20.9 (Fig. 17a), and then the guide tube 20.1 with the operating arm 20.2, whose end has a belt ring 20.8 to loosely guide the belt portion 1.1 (Fig. 17b);
- rotate those parts in front of the upper part of the body 95 at „ $\beta$ ” (Fig. 14), where the pin of the operating arm projects through the hole of the belt-feeding plate 20.9 or a clamping hole 20.11 of the belt-feeding plate 20.9a (Figs. 17c, e, f); and
- countersink all parts 20.1, 20.2, 20.9 or 20.9a in the seat backrest (Fig. 17d) to restrain the upper part of the body and both shoulders in the „X-shape” of both shoulder belt portions.

To prevent the entanglement of the belt portion 1.1 behind the seat, particularly when positioned furthest forward, that belt portion 1.1 in resting position is intercepted by the belt-catching element 20.7, 20.7a (Figs. 14, 17a, 17b).

When the seat 3c (Fig. 23) has a high seat backrest, the curved guide tube 20.1 of belt-feeding devices 20a (Fig. 15) can be modified in a straight-running operating arm 20.2 of the belt-feeding device 20.

In the 2nd or 3rd embodiment the belt-feeding device 20a or 20b is provided with a height-adjustable belt housing 20.4a and radial-adjustable tube 20.3 (Figs. 15, 16). Both devices differ from each other by the position of the guide tubes 20.1 on the seat backrest. Each guide tube can be driven by a drive apparatus, housed in the seat backrest. The guide tube 20.1 of the belt-feeding device 20a is pivotally attached in a stiff supporting tube 3.61 of the height-adjustable head rest 3.6a.

Adjustable is the height of „ $\Delta h$ ” of

- the belt housing 20.4a, having a latch plate 2, plug-in connected to any buckle assembly 4, 14, 18, by moving two openings, facing each other, along the operating arm 20.2a, and
- the belt deflector 5b by moving a handle 5.2, such as locking handle 27.5 of the height- and width-adjusting mechanism 27, 27a (Figs. 15, 19 to 22).

The belt-feeding devices 20a, 20b should meet the following criteria:

- it should be possible to freely get in and out of the vehicle compartment thanks to the distances of „a” and „b” between the post section 91 and operating arm 20.2a (Fig. 16) in resting position;
- there should be no contact with the head rest 3.6a, height-adjustable about „ $\Delta h_K$ ”, and with the head of the passenger with/without hat 92.

Regarding the kinematics of the height-adjustable belt housing 20.4a with the latch plate 2 from the operating position to the resting position, the trajectories of „Ba2” and „Bb” are not in the range of a hat thanks to a radial-adjustable tube 20.3 incorporated into the operating

arm 20.2a. Without the radial-adjustable tube 20.3 the operating arm in the trajectory of „Ba1” interferes with that hat.

In the 4th and 5th embodiment ref. to Figs. 18, 19 the belt-feeding devices 20c, 20d differ from each other by the rotatory movement of the operating arm 20.2, whose guide tube 20.1 is pivotally attached to a bearing casing 20.10. Preferably, upon the rotation about the head, the translatory and rotatory movement of belt are synchronized.

To form the upper part of the seat backrest frame 3.4d a pair of angle fittings 26a, a pair of rollover tubes 20.2b and a pair of side girders 27.1a or four tubes 27.1 (not drawn) are form- and/or force-locking connected to each other by connecting pins 26.2, 26.3 (drawn with dotted lines) and/or by welding, bolting, glueing and/or riveting. The belt housing 20.4c or 20.4d, having a moveable safety bracket 20.6, is guided by rollover tubes 20.2b and driven by an electrical motor 20.5 along the threaded spindle 20.1a, fastened to both angle fittings 26a, from the resting position (drawn with dotted lines) to the operating position, and back again. In the operating position the holes of the rollover tube 20.2b and belt housing 20.4d are aligned with each other, thus permitting the legs of the safety bracket 20.6, loaded in the event of rollover of a convertible, roadster or sport-utility vehicle, to project therethrough and clamp the shoulder belt portion 1.1.

Upon plug-in connection of the latch plate 2 with the buckle assembly 4, 4a, 4b the belt end ER of belt portion 1.1 is connected to the coupling part 1.2a, 1.2b (Figs. 12a, 12b), whereto a number of energy absorbers is attached to absorb energy. In a cost-saving embodiment without the latch plate 2 and buckle assembly, the belt end ER of belt portion 1.1 is directly connected to the coupling part 1.2a or 1.2b (Fig. 18) to receive energy absorbers, the retaining elements of which are fastened to the seat backrest frame 3.4d. In order to absorb great energy in the event turbulence-related vibrations of an aeroplane or accident of a fast speeding car or high-speed train, the belt retractor 13, coupling part 1.2b of which is connected to energy absorbers, is moveable attached to the oblong holes of a stiff plate 13.3, fastened to the seat backrest frame in the side SR so that the other belt end EL can be exploited to receive additional energy absorbers, as proposed by the inventor of the present application in the applications DE 197 58 497 A1 and WO 99/24292. In excess of threshold value the belt retractor pulls the clamping elements along the respective retaining elements to absorb energy and damp vibration.

In the 1st and 2nd embodiment (Figs. 12, 21) the buckle assembly 4a, 4b, 4c is form- and/or force-locking connected to the seat backrest frame.

For the convenience of the passenger to egress from the vehicle and in cases of emergency the following embodiments of disengagement are proposed:

To disconnect the latch plates 2, 11 and/or 25 from the buckle assemblies 14, 14a, 15, 15a (Fig. 1) and buckle assemblies 18, 18a, 18b, 18.1 to 18.3, 19, 19a, 19b, 19.1 to 19.3 (Fig. 23) of the seat arrangement, particularly for children, as well as from the buckle assemblies 7, 8, 8a to 8d (Figs. 1, 14), the master release button 84 is pressed, thus activating the release wires 4.2 and/or electrical motors 4.2b, which pull the release button 84a and/or 84b of the buckle assemblies (Figs. 12a, 12b, 21).

When depressing the master release button 84 the drive apparatus of the belt-feeding device 20, 20a to 20d returns the shoulder belt portion 1.1 from the operating position to the resting position.

According to the traffic- or flight law during the travel or turbulence-related flight passengers must remain belted. The need for a partial unrestrainedness of a belted passenger becomes apparent, when this passenger must take care of his (her) frightened children seating on the rear seat. The separately operated release button 84o, 84d, when depressed,  
5 disengages only the latch plates 11, 25 of the lap belt portion from the assemblies 7, 8, 8a, 8d (Figs. 1, 23) to annul the protection from submarining.

In the 1st embodiment (Figs. 19 to 21) the height- and width-adjusting mechanism 27 comprises a frame 29, buckle assembly 18.3, 19.3, a pair of tubes 27.4, parts 27.5 to 27.9 and  
10 a pair of tubes 27.1 having a plurality of locking slots, in form- and force-locking connection with an angle fitting 26a. The frame 29 consists of a pair of outer tubes 27.3, a pair of tubes 27.2 and a connecting part of all tubes. The locking handle 27.5 is form- and force-locking connected to the slots of the inner tubes 27.4.

These inner tubes 27.4, inserted into the outer tubes 27.3, are pre-loaded by the springs 27.6. Each spring 27.6 on a sleeve 27.7, secured by pin 27.8, protruding through the holes of the  
15 inner tube 27.4, presses against the spring rest 27.9 of the outer tube 27.3.

The locking handle 27.5 is in engagement with a pair of locking slots of tubes 27.1. The pulling of the locking handle 27.5 out from both slots results in disengagement, thus enabling the adjustment of the height of mechanism 27 and buckle assembly.

The outer tube 27.3 is provided with a plurality of locking slots q, r, s etc., drawn with dotted  
20 lines. in Figs. 20, 22.

After the pawl 18.10, pre-loaded by the spring 18.5, is disengaged from the locking slot r by its movement in the direction of arrow (Fig. 21), the housing 18.12, form-locking connected to the buckle assembly 4c, can be moved along both outer tubes 27.3.

The belt portion 1.1, 1.2, loosely guided by a U-shaped latch plate 25 (Figs. 19, 22), is  
25 loosely locked by the quick-release pin 25.1.

For juxtaposed seats in vehicles, buses, trains and aeroplanes it is recommended to use a single locking handle 27.5 to operate the 2nd embodiment of the height- and width-adjusting mechanism 27a of each seat 3c having e.g. three pairs of openings 18.1 / 19.1 to 18.3 / 19.3 to receive a pair of latch plates (Figs. 22, 23).

The frame 29a consists of two pairs of outer tubes 27.3, two pairs of tubes 27.2, a pair of connecting parts of all tubes and parts 18.3, 19.3, 27.6 to 27.9a, 27.11, attached to the outer tubes 27.3.

The locking handle 27.5 is form- and force-locking connected to slots of the inner tubes 27.4 by the pins 27.12. After inserting these inner tubes into the outer tubes 27.3 the locking plate  
35 27.10 is form- and force-locking connected to the slots of the inner tubes and to the pins 27.12.

After securing the spring rest 27.9a by the retaining rings 27.11, both sleeves 27.7a by the pins 27.8, protruding through the holes of inner tubes 27.4 and oblong holes of outer tubes 27.3, the inner tubes with locking handle 27.5 are pre-loaded by springs 27.6. By pulling the  
40 locking handle 27.5 out from both slots, the disengagement takes place, thus enabling the adjustment of the height of mechanism 27a.

After pulling and disengaging the locking handle 27.5 from both slots, the height of height- and width-adjusting mechanism 27a can be adjusted.

Although the present invention has been described and illustrated in detail, it is clearly  
45 understood that the terminology used is intended to describe rather than limit. Many more objects, embodiments, features and variations of the present invention are possible in light of the above-mentioned teachings. Therefore, within the spirit and scope of the appended claims, the present invention may be practised otherwise than as specifically described and illustrated.

What is claimed:

1. A multi-point, one-piece seat belt to increase the survival chance in the event of an accident of a vehicle, train or an aeroplane or turbulence-related vibrations of an aeroplane, comprising

5 several belt portions (1.1 to 1.4) and two belt ends (EL) and (ER), one belt end (EL) of which, equipped with a belt retractor (13), a clamping device and a D-ring (12), is arranged to a vehicle body generally representing a post section, vehicle-, train- or an aeroplane body or a floor (6);

10 a buckle assembly (9.1) arranged to the floor (6) generally representing a vehicle-, train- or an aeroplane floor or a side rail of the vehicle;

at least two latch plates (2, 9, 11, 25) and

a belt deflector (17), which is arranged to the floor (6), to deflect and loosely guide the belt portions (1.1, 1.3);

wherein

15 the lower part of body (96) is restrained by the lap belt portion (1.3) when the main latch plate (9) is plug-in connected to the buckle assembly (9.1) and

20 the upper part of body (95) is restrained by extending two shoulder belt portions (1.1, 1.2) crosswise in an X-shape when the shoulder latch plate (2), fastened to the other belt end (ER) of the first shoulder belt portion (1.1), is plug-in connected to a buckle assembly (4, 4b, 4c, 4e, 14, 14a, 18, 18a, 18b, 18.1 to 18.3) arranged to the side (SR) of a seat backrest.

2. A multi-point, one-piece seat belt to increase the survival chance in the event of an accident of a vehicle, train or an aeroplane or turbulence-related vibrations of an aeroplane, comprising

25 several belt portions (1.1 to 1.4) and two belt ends (EL) and (ER), one belt end (EL) of which, equipped with a belt retractor (13), a clamping device and a D-ring (12), is arranged in one side (SL) of a seat backrest (3.2, 3.2a to 3.2d) and the other belt end (ER) is arranged in the other side (SR) thereof;

a buckle assembly (9.1) arranged to one side of a seat frame (3.3, 3.3a to 3.3d);

30 at least one latch plate (2, 9, 11, 25) and

a belt deflector (17), which is arranged to the other side of the seat frame, to deflect and loosely guide the belt portions (1.1, 1.3);

wherein

35 the lower part of body (96) is restrained by the lap belt portion (1.3) when the main latch plate (9) is plug-in connected to the buckle assembly (9.1) and

the upper part of body (95) is restrained by extending two shoulder belt portions (1.1, 1.2) crosswise in an X-shape when the first shoulder belt portion (1.1) is moved from the resting position to the operating position.

3. A multi-point, one-piece seat belt to increase the survival chance in the event of an accident of a vehicle, train or an aeroplane or turbulence-related vibrations of an aeroplane, comprising

several belt portions (1.1 to 1.4) and two belt ends (EL) and (ER), one belt end (EL) of which, equipped with a D-ring (12), is arranged in one side (SL) of a seat backrest (3.2, 3.2a to 3.2d) and the other belt end (ER) is connected to a belt retractor (13) provided with a clamping device, arranged in the other side (SR) thereof; a buckle assembly (9.1) arranged to a seat frame (3.3, 3.3a to 3.3d); at least one latch plate (2, 9, 11, 25) and a belt deflector (17), which is arranged to a floor (6), to deflect and loosely guide the belt portions (1.1, 1.3);

wherein

the lower part of body (96) is restrained by the lap belt portion (1.3) when the main latch plate (9) is plug-in connected to the buckle assembly (9.1) and the upper part of body (95) is restrained by extending both shoulder belt portions (1.1, 1.2) crosswise in an X-shape when the first shoulder belt portion (1.1) is moved from the resting position to the operating position.

4. A multi-point, one-piece seat belt to increase the survival chance, whereby a belted passenger is protected from submarining, in the event of an accident of a vehicle, train or an aeroplane or turbulence-related vibrations of an aeroplane, comprising

several belt portions (1.1 to 1.4) and two belt ends (EL) and (ER), one belt end (EL) of which, equipped with a belt retractor (13), a clamping device and a D-ring (12), is arranged to the vehicle body and the other belt end (ER) is arranged in one side (SR) of a seat backrest (3.2, 3.2a to 3.2d); a buckle assembly (9.1) arranged to a seat frame (3.3, 3.3a to 3.3d); at least two latch plates (2, 9, 11, 25), at least one (11, 25) of which is movable along the lap belt portion (1.3); and a belt deflector (17), which is arranged to the seat frame, to deflect and loosely guide the belt portions (1.1, 1.3);

wherein

the lower part of body (96) is restrained by the lap belt portion (1.3) when the main latch plate (9) is plug-in connected to the buckle assembly (9.1) and the upper part of body (95) is restrained by extending both shoulder belt portions (1.1, 1.2) crosswise in an X-shape to the operating position;

both thighs of the passenger are restrained by two belt portions (1.3R, 1.3L) resulted from a subdivision of the lap belt portion (1.3) upon the plug-in connection of the latch plate (11, 25) with an additional buckle assembly (7, 8, 8a) arranged in a seat cushion (3.1, 3.1a to 3.1d).

5. A multi-point, one-piece seat belt to increase the survival chance, whereby a belted passenger in sleeping position is protected from submarining, in the event of an accident of a vehicle, train or an aeroplane or turbulence-related vibrations of an aeroplane, comprising several belt portions (1.1 to 1.4) and two belt ends (EL) and (ER), one belt end (EL) of which, equipped with a belt retractor (13), a clamping device and a D-ring (12), is arranged in one side (SL) of a seat backrest (3.2, 3.2a to 3.2d) and the other end (ER) is arranged in the other side (SR) thereof;  
a buckle assembly (9.1) arranged to a floor (6);  
at least two latch plates (2, 9, 11, 25), at least one (11, 25) of which is movable along the lap belt portion (1.3); and  
a belt deflector (17), which is arranged to a seat frame (3.3, 3.3a to 3.3d), to deflect and loosely guide the belt portions (1.1, 1.3);  
wherein  
the lower part of body (96) is restrained by the lap belt portion (1.3) when the main latch plate (9) is plug-in connected to the buckle assembly (9.1) and  
the upper part of body (95) is restrained by extending two shoulder belt portions (1.1, 1.2) crosswise in an X-shape to the operating position;  
when the passenger lies on the seat cushion and seat backrest, tilted back, his thighs are restrained by two belt portions (1.3R, 1.3L) resulted from a subdivision of the lap belt portion (1.3) upon the plug-in connection of the latch plate (11, 25) with an additional buckle assembly (8b, 8c) provided with a release button (84e) and a length-adjustable belt, which is attached to the seat frame.

6. A multi-point, one-piece seat belt according to claim 1, wherein a belt-feeding device (20a, 20b) consists of  
a belt housing (20.4a) equipped with the shoulder latch plate (2) and connected to one end of an operating arm (20.2a), the other end of which is connected to  
a guide tube (20.1) pivotally attached in the seat backrest;  
where the shoulder latch plate (2) of the first shoulder belt portion (1.1) is inserted into and connected to the buckle assembly (4, 14, 18) of the seat backrest by rotatable movement of the guide tube (20.1) upon plug-in connection of the main latch plate (9) with the buckle assembly (9.1).

7. A multi-point, one-piece seat belt according to claim 1, wherein a belt-feeding device (20a, 20b) consists of  
a belt housing (20.4a) equipped with the shoulder latch plate (2) and connected to one end of an operating arm (20.2a), the other end of which is connected to  
a guide tube (20.1) pivotally attached in a supporting tube (3.61) of the head rest (3.6a);  
where the shoulder latch plate (2) of the first shoulder belt portion (1.1) is inserted into and connected to the buckle assembly (4, 14, 18) of the seat backrest by rotatable movement of the guide tube (20.1) upon plug-in connection of the main latch plate (9) with the buckle assembly (9.1).

8. A multi-point, one-piece seat belt according to claim 2, wherein  
the belt end (ER) of the first shoulder belt portion (1.1) is connected to the seat backrest frame (3.4, 3.4c, 3.4d); and  
that shoulder belt portion (1.1) is moved from the resting position to the operating position by at least one feeding part (20.2, 20.4c, 20.4d) of a belt-feeding device (20, 20c, 20d).

9. A multi-point, one-piece seat belt according to claim 2, wherein the belt end (ER) of the first shoulder belt portion (1.1) is connected to a coupling member (1.2a, 1.2b) to receive energy absorbers; and that shoulder belt portion (1.1) is moved from the resting position to the operating position by at least one feeding part (20.2, 20.4c, 20.4d) of a belt-feeding device (20, 20c, 20d).

10. A multi-point, one-piece seat belt according to claim 3, wherein the belt retractor (13), moveably attached to a stiff plate (13.3) of the seat backrest frame, is provided with a coupling member (1.2a, 1.2b) to receive energy absorbers; the belt end (EL) is connected to energy absorbers; and the first shoulder belt portion (1.1) is moved from the resting position to the operating position by at least one feeding part (20.2, 20.4c, 20.4d) of a belt-feeding device (20, 20c, 20d).

11. A multi-point, one-piece seat belt according to claim 8, wherein the belt-feeding device (20c, 20d) serves as a rollover device, which is a member of the seat backrest frame (3.4d), along two rollover tubes (20.2b) of which the belt housing (20.4d), equipped with a safety bracket (20.6) with two legs movable therein, is movable, when the first shoulder belt portion (1.1) is in the operating position, the holes of the belt housing and of one of the rollover tubes (20.2b) are aligned with each other and in excess of a threshold value in the event of rollover both legs of the safety bracket protrude through the holes thereof, block the translatory movement of the belt housing and clamp the first shoulder belt portion (1.1).

12. A multi-point, one-piece seat belt according to claim 1, wherein the height- and width-adjusting mechanism (27) comprises a pair of tubes (27.1) of the seat backrest frame (3.4d) having a plurality of locking slots, one pair of which is engaged with a locking handle (27.5), that can be pulled to disengage therefrom and released to engage, when the height is adjusted; a frame (29) consisting of a pair of outer frame-tubes (27.2), movable along the inner frame-tubes (27.1), a connecting part of all frame-tubes (27.2, 27.3) and a pair of outer tubes (27.3), in which the inner tubes (27.4) are movable, biased by the springs (27.6) in co-operation with parts (27.7 to 27.9) and form- and force-locking connected to the locking handle (27.5); a plurality of locking slots arranged along one of the outer tubes (27.3); and at least one buckle assembly (18.3, 19.3), consisting of a buckle assembly (4c), to connect to the latch plate, and a housing (18.12), form-locking connected to the buckle assembly, movable along the outer tubes (27.3) and secured by a pawl (18.10) biased by a spring (18.5), engaged with the locking slot (r) and disengaged therefrom by pulling the pawl to adjust to the width of the seat backrest.

13. A multi-point, one-piece seat belt according to claim 1, wherein the height- and width-adjusting mechanism (27a) comprises

two pairs of tubes (27.1) of the seat backrest frame (3.4d) having a plurality of locking slots, two pairs of which are engaged with two locking parts (27.5, 27.10), coupled to each other, disengaged therefrom by pulling the locking handle (27.5) and engaged therewith again upon release;

a frame (29a) consisting of a pair of outer frame-tubes (27.2), movable along the inner frame-tubes (27.1), a connecting part of all frame-tubes and a pair of outer tubes (27.3), in which the inner tubes (27.4) are movable, biased by the springs (27.6) in co-operation with parts (27.7a, 27.8, 27.9a, 27.11) and form- and force-locking connected to the locking parts (27.5, 27.10);

a plurality of locking slots, arranged along one of the outer tubes (27.3); and one pair of buckle assemblies (18.3, 19.3), each of which consists of a buckle assembly (4c), for the purpose of plug-in connection to the latch plate, and a housing (18.12), form-locking connected thereto, movable along the outer tubes (27.3) and secured by a pawl (18.10) biased by a spring (18.5), engaged with the locking slot (r) and disengaged therefrom by pulling the pawl to adjust to the width of the seat backrest.

14. A multi-point, one-piece seat belt according to claim 1, wherein the belt deflector (17) comprises a housing, having an attachment hole, and a pin (17.1), attached in the housing to form an aperture.

15. A multi-point, one-piece seat belt according to claim 14, wherein the pin (17.1) is surrounded by a sleeve (17.2).

16. A multi-point, one-piece seat belt according to claim 14, wherein the shoulder latch plate (2) is loosely retained by the aperture of the belt deflector (17).

17. A multi-point, one-piece seat belt according to claim 14, wherein the belt deflector (17) is made of one piece.

18. A multi-point, one-piece seat belt according to claim 1, wherein the shoulder latch plate (2), easily accessed by the passenger when intending to use the belt, in the resting position is plug-in connected to a buckle assembly (16, 16a, 16b), which is arranged to the seat backrest (3.2).

19. A multi-point, one-piece seat belt according to claim 1, wherein the shoulder latch plate (2), easily accessed by the passenger when intending to use the belt, in the resting position is plug-in connected to a buckle assembly (16, 16a, 16b), which is arranged to the post section.

20. A multi-point, one-piece seat belt according to claim 1, wherein the shoulder latch plate (2), easily accessed by the passenger when intending to use the belt, in the resting position is plug-in connected to a buckle assembly (16, 16a, 16b), which is arranged to the seat cushion (3.1).

21. A multi-point, one-piece seat belt according to claim 4, wherein the belt-feeding device (20, 20a to 20d) is operated by at least one electrical motor (20.5).



22. A multi-point, one-piece seat belt according to claim 21, wherein the rotatable movement of the operating arm (20.2) together with the shoulder belt portion (1.1) and the translatory movement of the belt housing (20.4d) are synchronized by the drive apparatus of the belt-feeding device (20d).

5 23. A multi-point, one-piece seat belt according to claim 21, wherein a belt housing (20.4a), having the shoulder latch plate (2), is adjustable in height by moving two openings, facing each other, along the operating arm (20.2a).

24. A multi-point, one-piece seat belt according to claim 23, wherein a radial-adjustable tube (20.3) is arranged to the guide tube (20.1) of the belt-feeding device (20a, 20b).

10 25. A multi-point, one-piece seat belt according to claim 23, wherein the height-adjustable belt housing (20.4a), having the shoulder latch plate (2), is arranged to the guide tube (20.1) of the belt-feeding device (20a, 20b).

15 26. A multi-point, one-piece seat belt according to claim 1, wherein the belt deflector (5b), located on the top edge of the seat backrest at the side (SL) thereof, is adjustable in height by moving a handle (5.2, 27.5).

27. A multi-point, one-piece seat belt according to claim 1, wherein the belt deflector (5a) is attached to the head rest (3.6a).

28. A multi-point, one-piece seat belt according to claim 21, wherein the belt-feeding device (20) comprises

20 the operating arm (20.2), to one end of which a belt ring (20.8) is rigidly attached to loosely guide the first shoulder belt portion (1.1) and to the other end of which a guide tube (20.1) is rigidly attached, where the guide tube (20.1), pivotally attached to the bearing casing (20.10) of the seat backrest frame, is rotated and countersunk in the seat backrest by a drive apparatus; and

25 a belt-feeding plate (20.9, 20.9a) to maintain the first shoulder belt portion (1.1) over the head rest (3.6) during the rotation and to receive the operating arm (20.2).

29. A multi-point, one-piece seat belt according to claim 28, wherein the belt-feeding device (20) in the resting or operating position is countersunk in the seat backrest.

30 30. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) in response to actuating a switch, where the drive apparatus is switched off when the operating position is reached.

35 31. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) in response to pressing x-times the master release button (84) of the buckle assembly (9.1), where the drive apparatus is switched off when the operating position is reached.

40 32. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) in response to activating a switch, attached in the buckle assembly (9.1), upon contact with a cam of the main latch plate (9), when inserted therein, where the drive apparatus is switched off when the operating position is reached.

33. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) in response to starting an engine, where the drive apparatus is switched off when the operating position is reached.

5 34. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) when the passenger closes a vehicle door, where the drive apparatus is switched off when the operating position is reached.

10 35. A multi-point, one-piece seat belt according to claim 21, wherein the first shoulder belt portion (1.1) is moveable from the resting position to the operating position by activating the drive apparatus of the belt-feeding device (20, 20a to 20d) when the passenger takes his seat, where to a pressure sensor is built, where the drive apparatus is switched off when the operating position is reached.

15 36. A multi-point, one-piece seat belt according to claim 21, wherein the drive apparatus is operable to return the first shoulder belt portion (1.1) from the operating position to the resting position, when a dwell time, predetermined for the insertion of the shoulder latch plate (2) into the buckle assembly (4, 4a to 4c, 14, 14a, 18), is exceeded.

20 37. A multi-point, one-piece seat belt according to claim 4, wherein upon the pressure on the master release button (84) of the buckle assembly (9.1) an electrical motor (4.2b) pulls the release button (84b) of the buckle assembly (4b) to disengage the latch plate.

38. A multi-point, one-piece seat belt according to claim 37, wherein on depressing the master release button (84) all the latch plates (2, 9, 11, 25) are disengaged from the buckle assemblies of the seat.

25 39. A multi-point, one-piece seat belt according to claim 21, wherein on depressing the master release button (84) the drive apparatus of the belt-feeding device (20, 20a to 20d) returns the first shoulder belt portion (1.1) from the operating position to the resting position and all the latch plates (2, 9, 11, 25) are disengaged from the buckle assemblies of the seat.

30 40. A multi-point, one-piece seat belt according to claim 4, wherein upon the pressure on a release button (84a), arranged to the seat cushion, a release cable (4.2) pulls the release button (84a) of the buckle assembly (4a, 7, 8, 8a) of the seat cushion to disengage the latch plate of the lap belt portion.

35 41. A multi-point, one-piece seat belt according to claim 4, further comprising a belt-catching element (20.7, 20.7a), attached to the seat backrest, to intercept the first shoulder belt portion (1.1) when in the resting position.

## ABSTRACT

Despite the continuous improvement of the prior-art restraint systems severe/fatal injuries of passengers, restrained thereby, are increasing in accidents due to submarining, three-point seat belts, capable of restraining only one shoulder, or lap seat belts of aeroplanes, incapable of restraining the upper part of the body and head [4, 5], and impact of their heads with aeroplane- or vehicle interiors such as steering wheel [7] or window pane [8], thus resulting in head- and organ injuries [6, 9].

In the principle feature of invention survival chance for babies, children and adults in accidents of vehicles, trains or aeroplanes or in turbulence-related vibrations of aeroplanes is enhanced when the upper part of body of a passenger and his shoulders are restrained by extending both shoulder-belt portions (1.1, 1.2) of a multi-point, one-piece seat belt (1) crosswise in an X-shape and his lower part of body is restrained when plug-in connecting a latch plate (2), easily accessed by the passenger, to a buckle assembly (4) and a latch plate (9) to a buckle assembly (9.1).

In the second feature the X-shaped restraint is accomplished by a belt-feeding device when the passenger takes his seat.

In the third feature both thighs are restrained by two lap-belt portions (1.3R, 1.3L) when plug-in connecting a latch plate (11) to a buckle assembly (8).

In the fourth feature, for the convenience of passenger or in cases of emergency all latch plates are disengaged when pressing a master release button (84) of the buckle assembly (9.1).

## OTHER PUBLICATIONS

[1] Report "Fahrzeugsicherheit 90" by Institut für Fahrzeugsicherheit in München

[2] Car-Magazine AMS (Auto Motor und Sport) 2/94, 10/94, 6/95, 17/95, 19/95, 20/95, 25/95, 8/96, 14/96, 10/97, 15/97, 19/97, 20/97, 21/97

[3] Car-Magazine AMS 21/97

[4] Car-Magazine AMS 19/95, 20/97

[5] Car-Magazine AMS 19/91

[6] Police accident report and medical reports of court case regarding instant death of a 39 years-old driver, 40 years-old co-driver and 11 years-old child in a German car, crashed by another German car on a rural road, due to massive brain injuries, fracture of skulls, ribs, shanks, femurs, rupture of aortas, livers, spleens, kidneys etc.

[7] Police accident report and photos documenting the steering wheel and -column totally deformed by the head, thrown forward, of a 34 years-old driver of a brand-new German luxury car.

[8] Police accident report and newspaper documenting the instant death of a 21 years-old female driver in a German car, crashing into a larger German car on an urban road, due to the head impact with the window pane.

[9] 34-page report by Go concerning severe/fatal injuries, submarining, head impacts and whiplash resulted from failure of conventional seat belts etc. to four German Ministers, General Attorney, Vice General Attorney, Chief Attorneys, Police Chief Directors, Police Directors, Police Chiefs etc.

Table 1

	left / right femur-force of driver	left / right femur-force of co-driver	belt-force of driver / co- driver	U <sub>H</sub>
Fiat Tipo®	15190 N	nR N	5620 / 6100 N	20 / 80°
Opel Corsa®	2258 / 2700	1381 / 2315	7030 / 7310	25 / 90
VW Polo®	2785	1587	5142 / 5655	45 / 70
Fiat Bravo®	3700	2300	nR / 6800	10 / 45
VW Golf®	2340	1630	6040 / 7050	50 / 50
MB C®	6858	2362	6015 / 6685	20 / 30
MB E200® ohne Airbag	1480	2140	8220 / 8380	/
VW Passat®	1600	2100	3400 / 4700	20 / 40
AUDI A6®	700 / 1200	1500 / 1100	6900 / 8400	25 / 50
Opel Omega®	2750	2180	6580 / 6160	nR / 40
BMW 528i®	1400 / 1200	900 / 1300	3600 / 3400	10 / 30
MB E320®	2200 / 1700	1200 / 900	3000 / 3800	5 / 30
AUDI A8®	2360	2610	9130 / 8510	40 / 50
BMW Z3®	1300 / 1400	1300 / 900	8300 / 4400	0 / 10
MB SLK®	5100 / 1700	800 / 4400	3300 / 3700	0 / 40
FB	nR / 8300	2733 / 3980	6144 / 5415	5 / 85
Renault Espace®	2037 / 11206	1323 / 1418	6829 / 7885	5 / 90
Opel Sintra®	4100	4700	5300 / 6400	60 / 30
VW Sharan®	2300	2600	6500 / 5700	35 / 70

FB = Peugeot 806®, Citroen Evasion®, Fiat Ulysse®, Lancia Zeta®

nR = no result

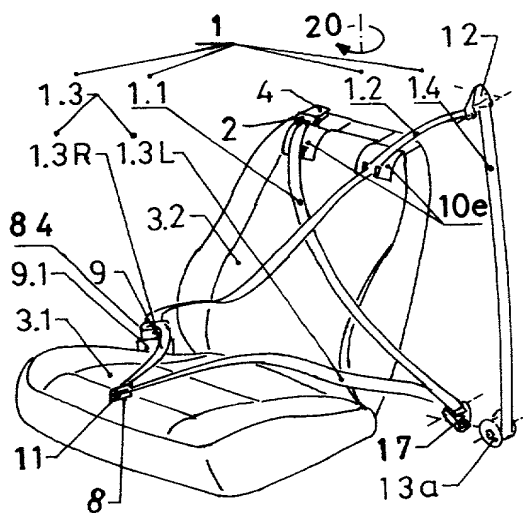
Table 2

	yaw O of driver / co-driver
BMW Z3®	85 / 90°
MB SLK®	100 / nR

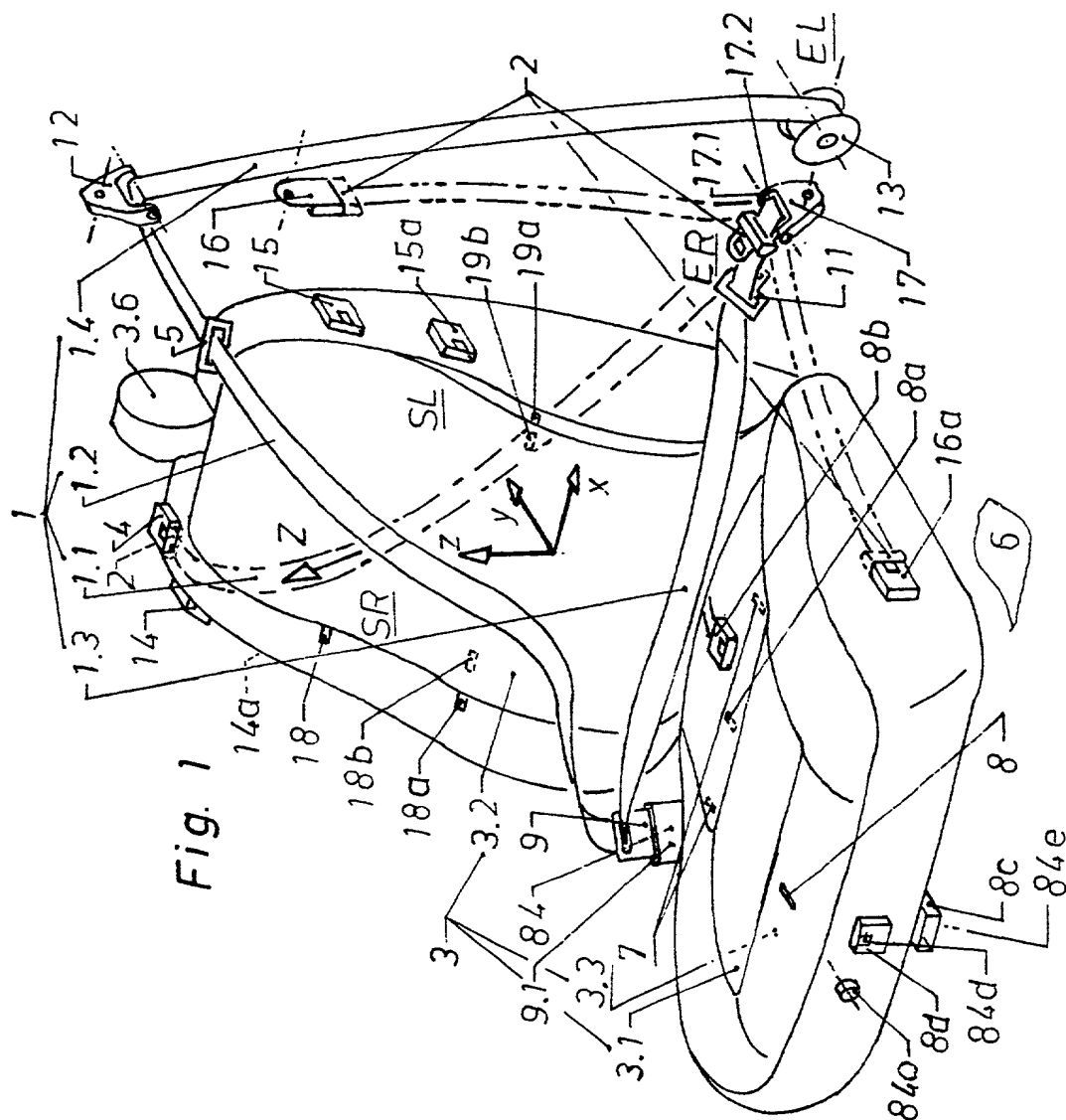
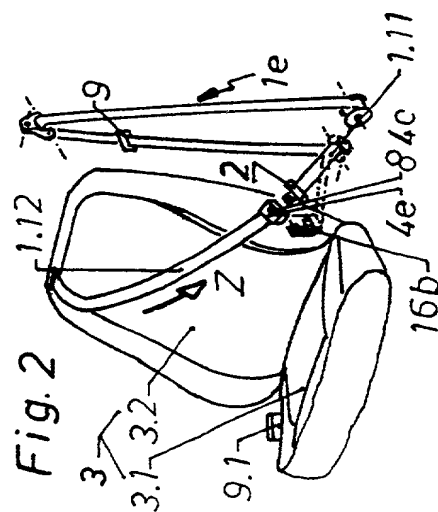
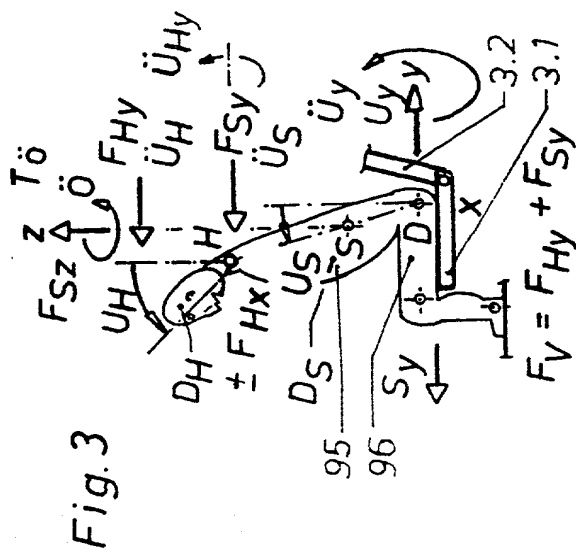
Table 3

	force of head	acceleration of head	acceleration of chest	force of neck	forward motion
child-seat	696 HIC	65 g	59 g	1516 N	552 mm
AUDI A4®	392	49	45		
MB E320®	229	38	40		
child-seat to MB E320®	304 %	171 %	148 %		

0003

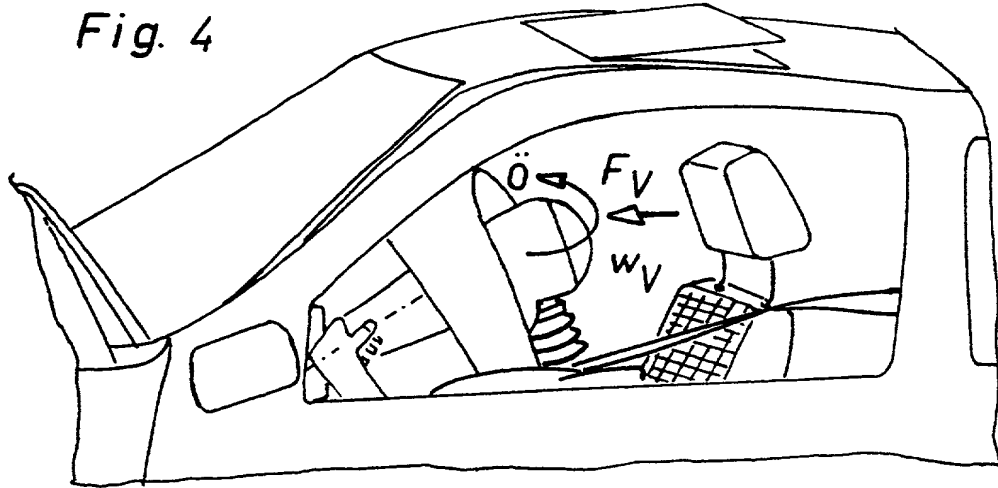


## Prior Art



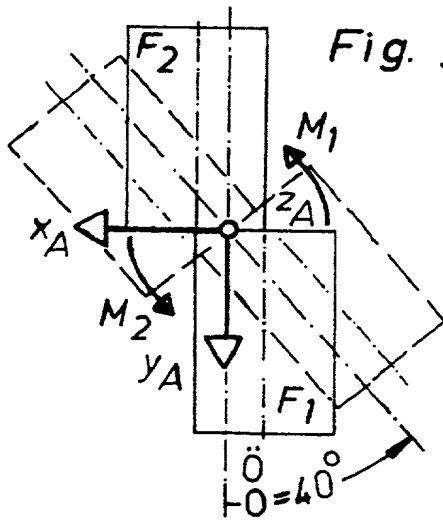
Prior Art

Fig. 4



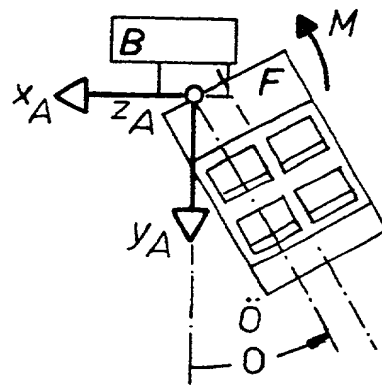
Prior Art

Fig. 5



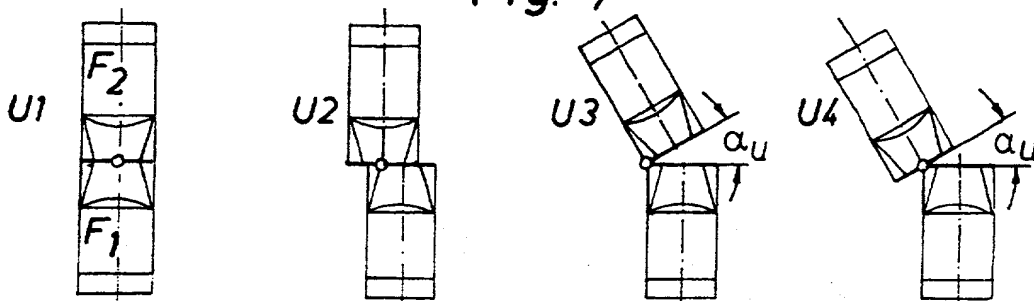
Prior Art

Fig. 6



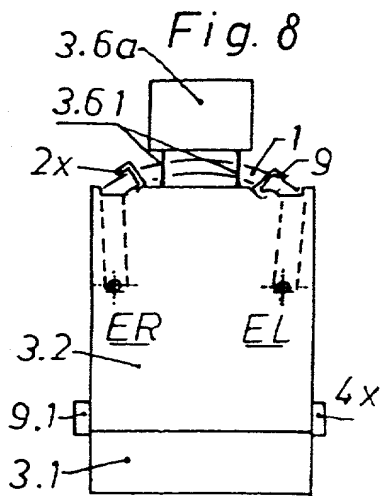
Prior Art

Fig. 7

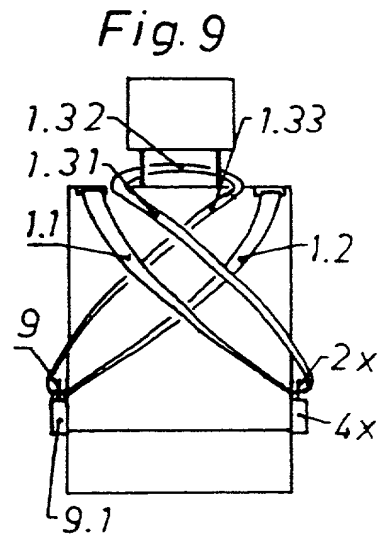


# Prior Art

Prior Art

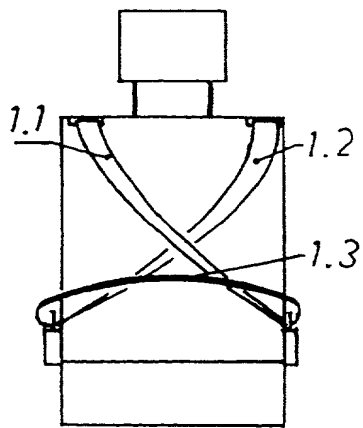


Prior Art



Prior Art

*Fig. 10*



*Fig. 11*

Prior Art

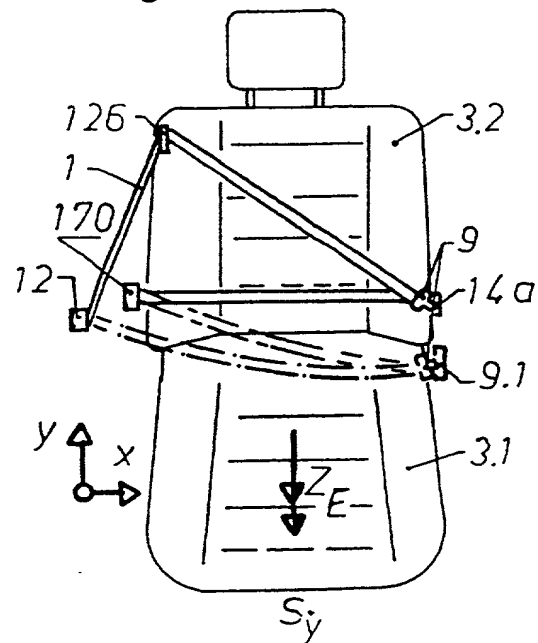




Fig. 12a

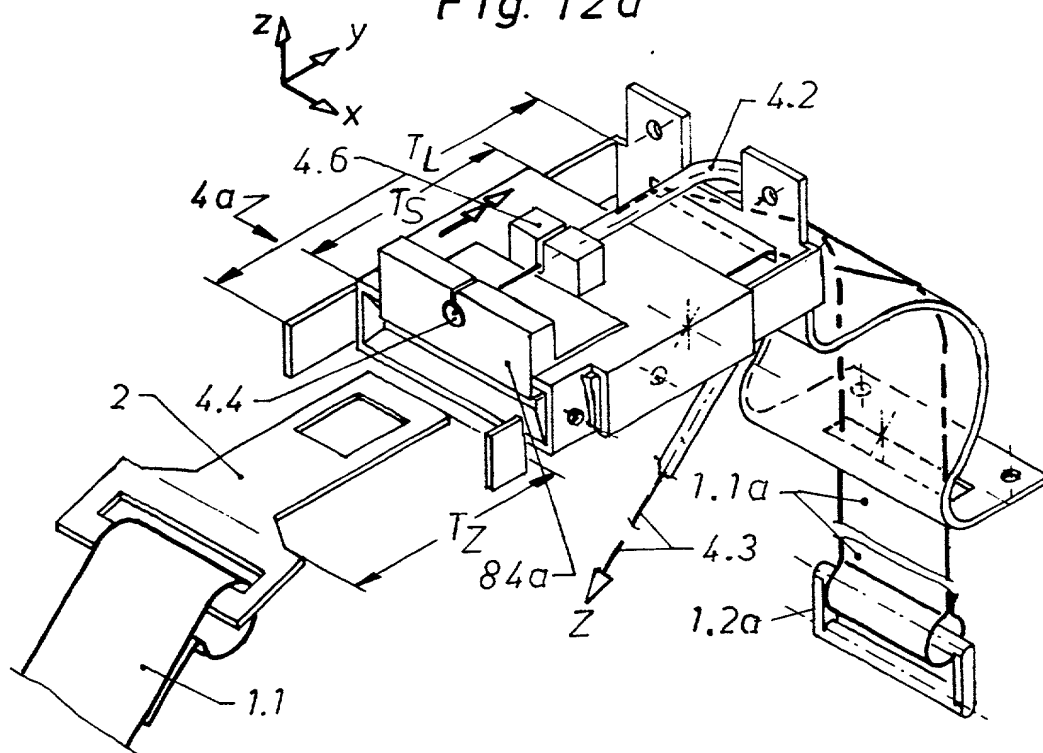
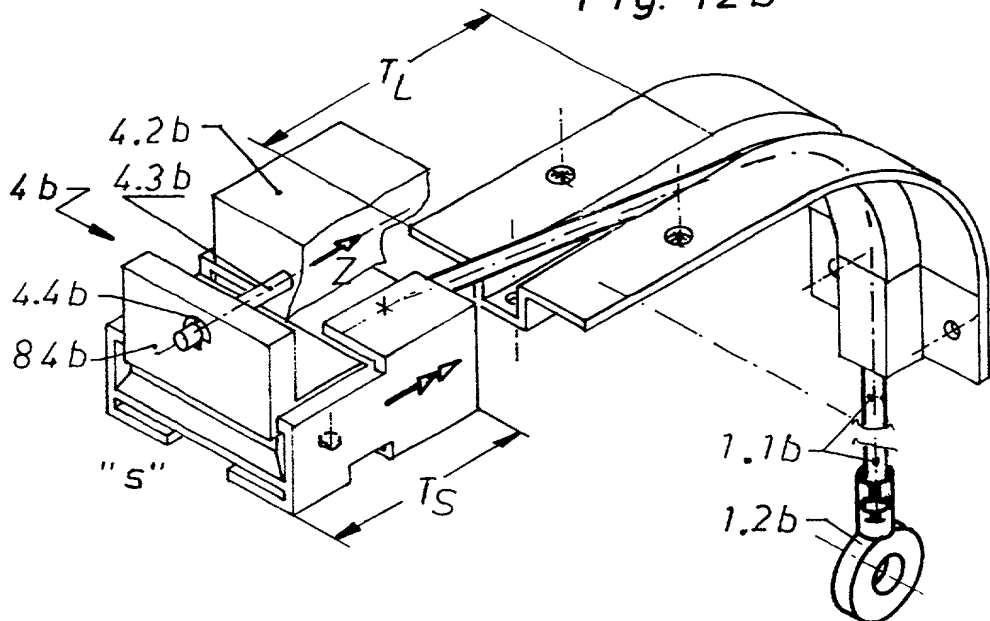
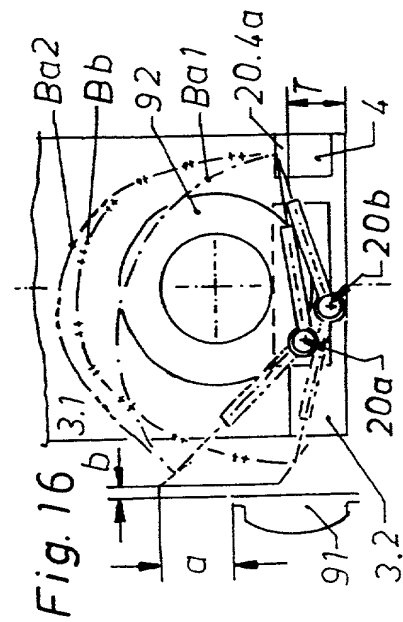
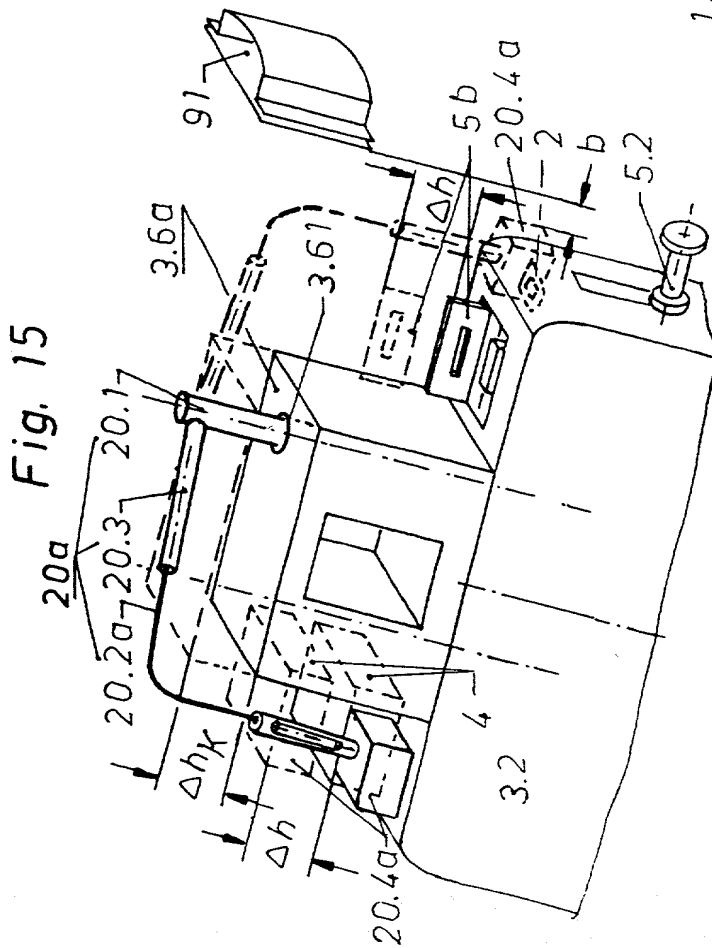
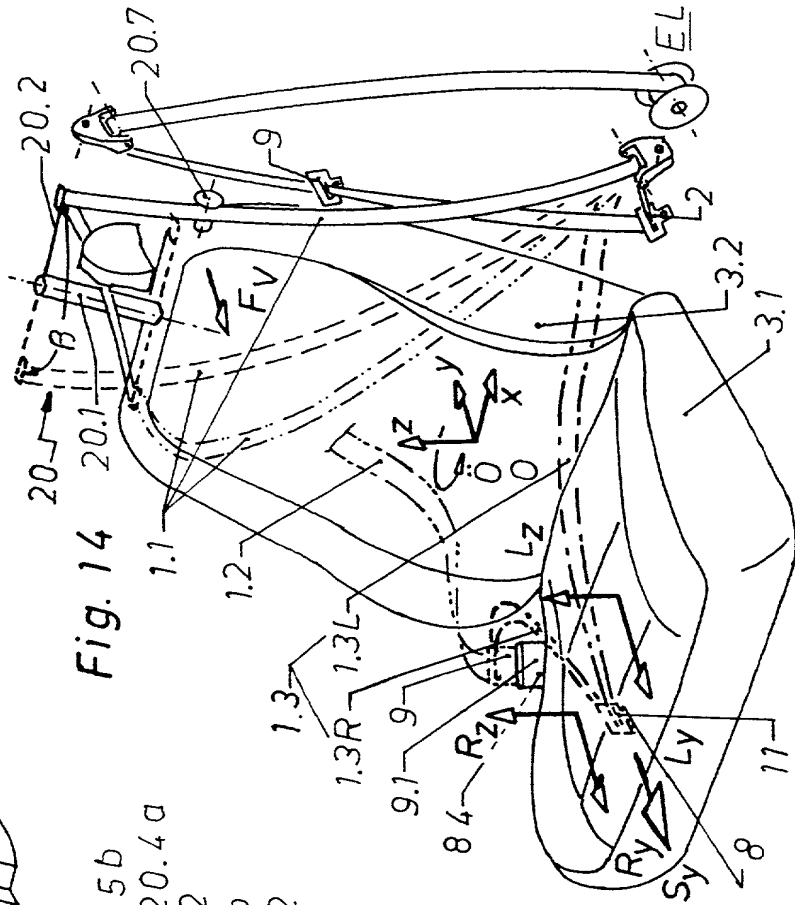
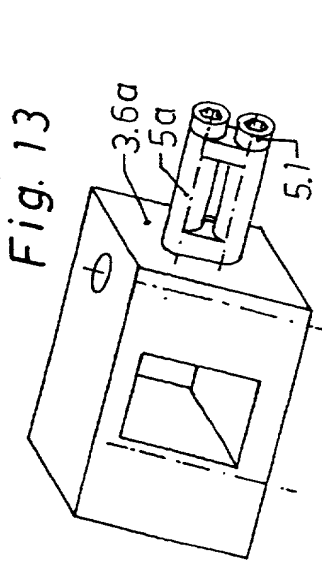
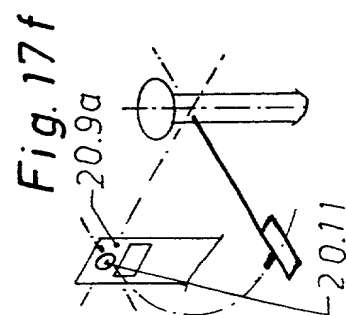
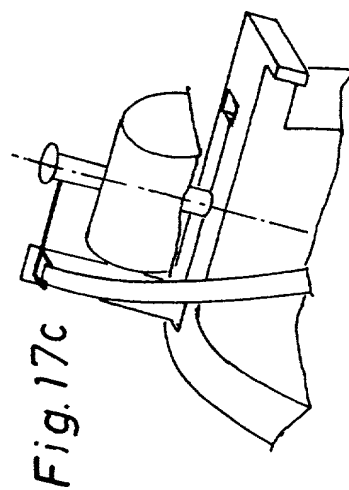
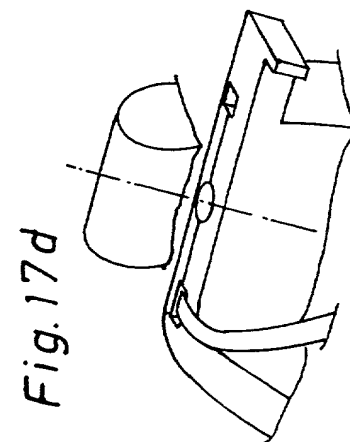
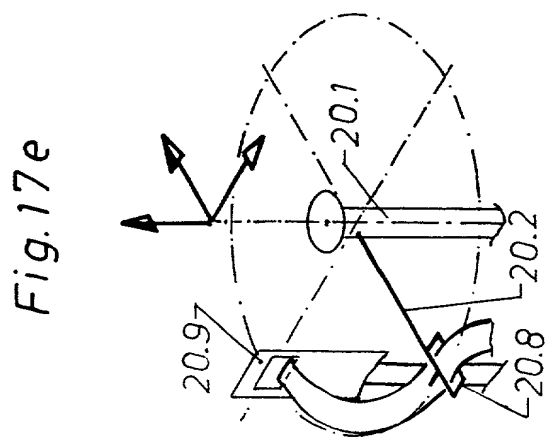
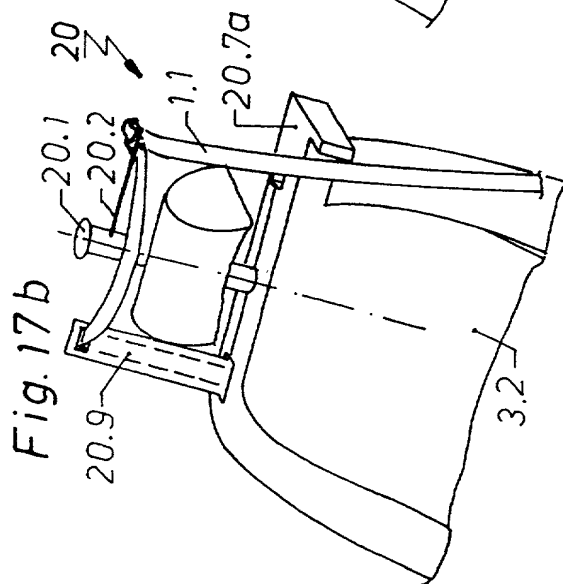
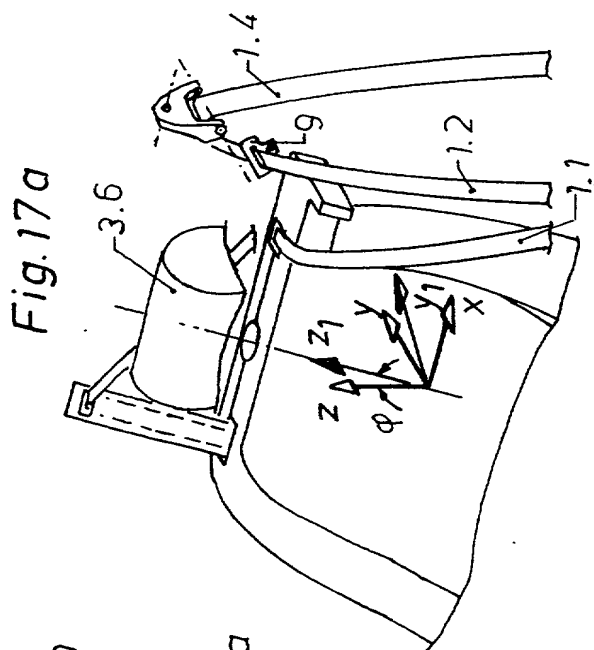


Fig. 12b









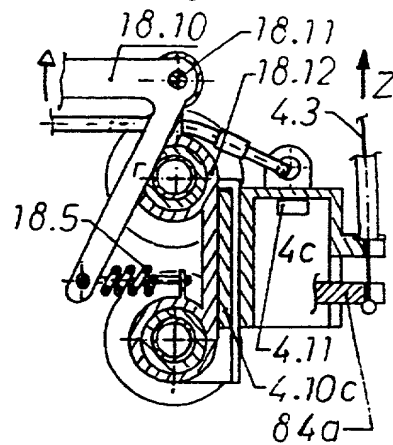
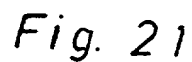
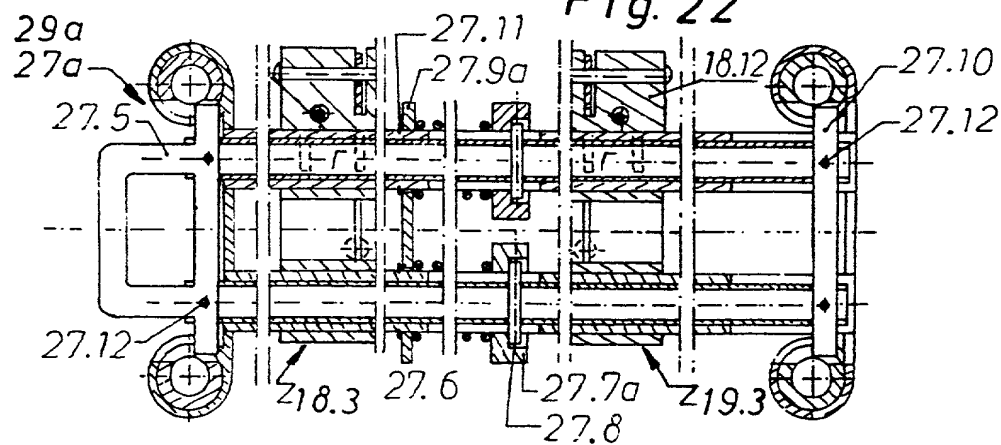
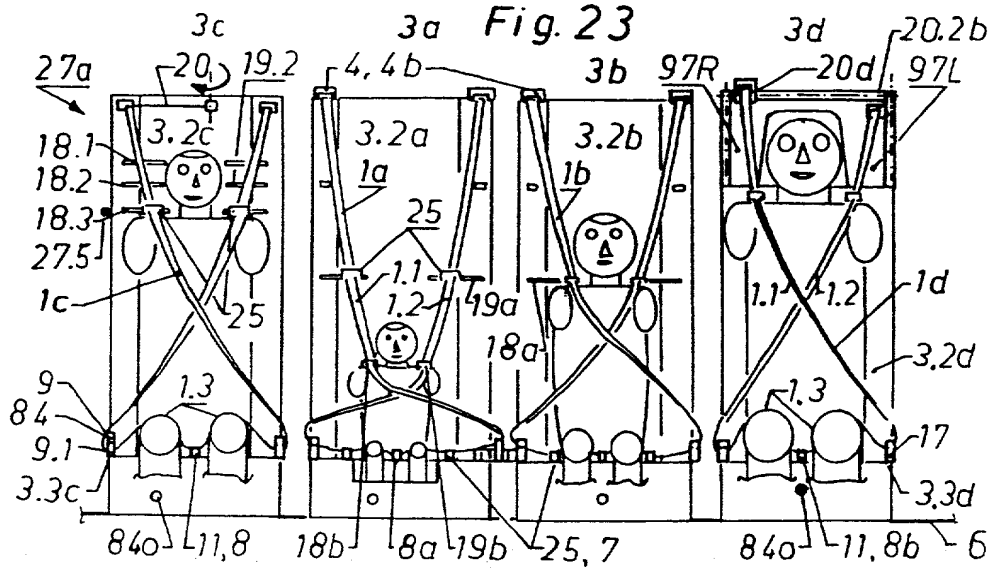


Fig. 22



*Fig. 23*



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# DECLARATION

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s), or §365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority sheet attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number

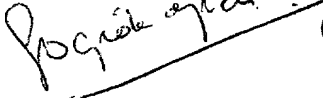
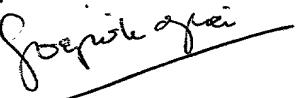
☐ Additional registered practitioner(s) named on a supplemental sheet attached hereto.

Direct all correspondence to:

<b>Name</b>	Giok Djien Go				
<b>Address</b>	Pfahlgrabenstr 45				
<b>Address</b>					
<b>City</b>	Idstein	<b>State</b>	Hessen	<b>ZIP</b>	65510
<b>Country</b>	Germany	<b>Telephone</b>	+49 6126 8949	<b>Fax</b>	+49 6126 52614

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

☐ A petition has been filed for this unsigned inventor

Given Name	Giok Djien			Middle Initial		Family Name	Go		Suffix e.g. Jr.	
Inventor's Signature	 						Date	April 04, 2000		
Residence: City	Idstein			State		Country	Germany		Citizenship	German
Post Office Address	Pfahlgrabenstr 45									
Post Office Address	D-65510 Idstein									
City	Idstein			State		Zip	65510		Country	Germany
<input type="checkbox"/> Additional inventors are being named on supplemental sheet(s) attached hereto										

☐ Additional inventors are being named on supplemental sheet(s) attached hereto

Please type a plus sign (+) inside this box → ☐

PTO/SB/01 (8-96)

Approved for use through 9/30/98. OMB 0651-0032

Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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## DECLARATION

## PRIORITY DATA (Supplemental Sheet)

### Additional foreign applications:

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
See list of PCT/US 98/03270 documents	Nine related prior apps are enclosed		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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### Additional provisional applications:

Application Number	Filing Date (MM/DD/YYYY)

### Additional U.S. applications:

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

PTO/SB/09 (6-95)  
 Approved for use through 07/31/96. OMB 0651-0031  
 Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS  
 (37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR**

Docket Number (Optional)

Applicant or Patentee: Giok Djien Go

Application or Patent No.: PCT/DE 98/03276

Filed or Issued: Nov 10, 1998

Title: Multi-point, one-piece seat bar

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.  
☒ the application identified above.  
☒ the patent identified above.

US 5,749,780 A1

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☐ No such person, concern, or organization exists.  
☐ Each such person, concern or organization is listed below.

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Giok Djien Go

NAME OF INVENTOR

NAME OF INVENTOR

NAME OF INVENTOR

*Giok Djien Go*  
 Signature of inventor

Signature of inventor

Signature of inventor

Date April 22, 2000

Date

Date

Burden Hour Statement: This form is estimated to take .3 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



PTO/SB/10 (6-95)  
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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

<b>VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS</b> <b>(37 CFR 1.9(f) &amp; 1.27(c))--SMALL BUSINESS CONCERN</b>	Docket Number (Optional) _____
--	--------------------------------

Applicant or Patentee: Giok Djien Go  
 Application or Patent No.: PCT/DE 93/03270  
 Filed or Issued: Nov 10, 1998  
 Title: Multi-printing one-piece sheet body

I hereby declare that I am  
☐ the owner of the small business concern identified below:  
☐ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN \_\_\_\_\_  
 ADDRESS OF SMALL BUSINESS CONCERN \_\_\_\_\_

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

☐ the specification filed herewith with title as listed above.  
☐ the application identified above.  
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in the invention must file separate verified statements averring to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization having any rights in the invention is listed below:  
☐ no such person, concern, or organization exists.  
☐ each such person, concern or organization is listed below.

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Giok Djien Go

NAME OF PERSON SIGNING \_\_\_\_\_

TITLE OF PERSON IF OTHER THAN OWNER \_\_\_\_\_  
Pfahlgrabenstr 45 D-65510 Idstein Germany

ADDRESS OF PERSON SIGNING \_\_\_\_\_

SIGNATURE Giok Djien Go DATE April 04, 2000

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